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ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

T.4

Amendment 2
(10/97)

SERIES T: TERMINALS FOR TELEMATIC SERVICES

Standardization of Group 3 facsimile terminals for document transmission

Amendment 2

ITU-T Recommendation T.4 – Amendment 2

(Previously CCITT Recommendation)

ITU-T T-SERIES RECOMMENDATIONS

TERMINALS FOR TELEMATIC SERVICES

For further details, please refer to ITU-T List of Recommendations.

ITU-T RECOMMENDATION T.4

STANDARDIZATION OF GROUP 3 FACSIMILE TERMINALS FOR DOCUMENT TRANSMISSION

AMENDMENT 2

Summary

Amendment 2 contains some amendments to the main body and Annex E to Recommendation T.4 to cover the introduction of a Talker Echo Protection (TEP) signal with the V.29 modulation system.

Amendment 2 contains also new Annex H. This new Annex H to Recommendation T.4 together with the associated amendments to the main body of Recommendation T.4 specify the technical features of the Mixed Raster Content (MRC) mode which enables efficient processing, interchange and archiving of raster-oriented pages containing a mixture of multilevel and bi-level images. This efficiency is realized through segmentation of the image into multiple layers (planes), as determined by image type, and applying image specific encoding, spatial and colour resolution processing.

A rasterized page may contain three (3) image types: multilevel continuous-tone or palettized colours (contone) usually associated with naturally occurring images; bi-level detail associated with text and line-art; multilevel colours associated with the text and line-art. This Recommendation makes provisions for processing, interchange, and archiving of these three image types in separate layers. The original image may be regenerated by recombining the layers in a prescribed manner.

Source

ITU-T Recommendation T.4, Amendment 2, was prepared by ITU-T Study Group 8 (1997-2000) and was approved under the WTSC Resolution No. 1 procedure on the 16th of October 1997.

FOREWORD

ITU (International Telecommunication Union) is the United Nations Specialized Agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of the ITU. The ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

INTELLECTUAL PROPERTY RIGHTS

The ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. The ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

As of the date of approval of this Recommendation, the ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

CONTENTS

STANDARDIZATION OF GROUP 3 FACSIMILE TERMINALS FOR DOCUMENT TRANSMISSION

AMENDMENT 2

(Geneva, 1997)

1) Append the following sentences at the end of 2.1:

"Optionally, multilevel data and bi-level data resulting from the coding of colour gray-scale and text/line-art respectively, may be transmitted on the same page as described in Annex H/T.4 (Mixed Raster Content). All of the dimensions of Group 3 may be used with the procedure in Annex H/T.4. A non-square resolution of 8 × 3.85 lines/mm is not supported by Annex H/T.4"

2) Amend Table 1/T.4 as shown below:

"**Table 1/T.4**

Resolution (pels/25.4 mm)	**Tolerance**	**Number of picture elements along a scan line**		
		ISO A4, North American Letter/Legal	**ISO B4**	**ISO A3**
Horizontal 100 Vertical 100	± 1%	864/219.46 mm	1024/260.10 mm	1216/308.86 mm
Horizontal 200 Vertical 200	± 1%	1728/219.46 mm	2048/260.10 mm	2432/308.86 mm
Horizontal 300 Vertical 300	± 1%	2592/219.46 mm	3072/260.10 mm	3648/308.86 mm
Horizontal 400 Vertical 400	± 1%	3456/219.46 mm	4096/260.10 mm	4864/308.86 mm
NOTE – The resolutions 200 × 200 pels/25.4 mm and 8 × 7.7 lines/mm can be considered as being equivalent. Similarly, the resolutions 400 × 400 pels/25.4 mm and 16 × 15.4 lines/mm can be considered also as being equivalent. Consequently, conversion between mm based terminals and inch based terminals is not required for the communications in these cases. However, communication between these resolutions will cause the distortion and the reduction of reproducible area.				

"

3) In 5.2 add a new Note 6 as follows:

In 5.2 add a new Note 6 as follows:

"NOTE 6 – When V.29 signalling is used, a Talker Echo Protection (TEP) signal may, optionally, be transmitted prior to the transmission of training and synchronisation sequences. The TEP signal shall consist of an unmodulated carrier for a duration of 185 to 200 ms followed by a silence period of 20 to 25 ms. It should be noted that this signal may cause compatibility problems with some existing terminals that still conform to the 1996 version and previous versions of Recommendation T.4. "

4) Add the following subclause to the end of Recommendation T.4:

16 Mixed Raster Content

Mixed Raster Content is an optional feature of Group 3 that allows the representation of multilevel and bi-level data together on a page. This mode is specified in Annex H/T.4."

Amendment to Annex E to Recommendation T.4

1) Amend the definition for "Resolution" within E.6.5/T.4 to include 100 pels/25.4 mm resolution.

"Resolution Allowed values are 100, 200, 300, and 400 pels/25.4 mm, with square (or equivalent) pels."

Annex H

Mixed Raster Content (MRC) for G3 facsimile

H.1 Scope

The method for Mixed Raster Content (MRC) image representation is defined in Recommendation T.44. Together with Annex J/T.30, this Annex provides specification for the application of MRC in Group 3 facsimile. MRC defines a means to efficiently represent raster-oriented pages which contain a mixture of multilevel (e.g. continuous-tone and palettized colour) and bi-level (e.g. text and line-art) images by combining different encodings, spatial and colour resolutions on a single page. More than one of the multilevel encodings (e.g. T.81 and T.82 as per T.43) and bi-level encodings (e.g. T.6 and T.4, one and two-dimensional) which are available in Recommendation T.30 may be combined within a page; however, only bi-level encodings may be used in the MRC mask layer. Similarly more than one of the square spatial resolutions (same resolution in both horizontal and vertical direction) and colour resolutions (i.e. bits/pels/component and chrominance subsampling) which are available in Recommendation T.30 may be combined within a page. This Annex does not introduce new encodings or resolutions. The method of image segmentation is beyond the scope of this Annex, segmentation is left to manufacturer's implementations.

H.2 References

– CCITT Recommendation T.6 (1988), *Facsimile coding schemes and coding control functions for Group 4 facsimile apparatus.* (Commonly referred to as MMR standard.)

– ITU-T Recommendation T.30 (1996), *Procedures for document facsimile transmission in the general switched telephone network.*

– ITU-T Recommendation T.42 (1996), *Continuous-tone colour representation method for facsimile.*

– ITU-T Recommendation T.43 (1997), *Colour and gray-scale image representations using lossless coding scheme for facsimile.*

– ITU-T Recommendation T.44 (1997), *Mixed Raster Content (MRC).*

– CCITT Recommendation T.81 (1992) | ISO/IEC 10918-1:1993, *Information technology – Digital compression and coding of continuous-tone still images – Requirements and guidelines.* (Commonly referred to as JPEG standard.)

– ITU-T Recommendation T.82 (1993) | ISO/IEC 11544:1993, *Information technology – Coded representation of picture and audio information – Progressive bi-level image compression.* (Commonly referred to as JBIG standard.)

– ITU-T Recommendation T.85 (1995), *Application profile for Recommendation T.82 – Progressive bi-level image compression (JBIG coding scheme) for facsimile apparatus.*

H.3 Definitions

The definitions contained in Recommendations T.6, T.30, T.42, T.43, T.44, CCITT Rec. T.81 | ISO/IEC 10918-1, ITU-T Rec. T.82 | ISO/IEC 11544 and Recommendation T.85, apply unless explicitly amended.

H.3.1 layer: An image, either multilevel or bi-level, which is to be combined with other images using the method described here. Layers are encoded using ITU-T coding methods. One or more layers may be used.

H.3.2 **contone**: Continuous-tone and/or palettized colour. This definition is intended to account for both scanner and synthetic source image data. When a scanner is the source of an image, both continuous-tone and solid coloured images would be available as continuous-tone data. When the source of an image is synthetic, continuous-tone and solid coloured images may be available as continuous-tone or palettized colour data.

H.3.3 **background layer**: The "bottom" layer (layer 2), multilevel data associated with a contone image segment, in a 3-layer segmentation of a page containing a combination of bi-level and multilevel images.

At background pixel locations where the contone background image is not present, a default background colour (white) is applied. A means to define other values of background colour is provided within the syntax described in clause 9.

H.3.4 **foreground layer**: The "top" layer (layer 3), multilevel data associated with colours of text, graphics or line-art, in a 3-layer segmentation of a page containing a combination of bi-level and multilevel images.

At foreground pixel locations where the multilevel data associated with colours of text, graphics or line-art is not present, a default foreground colour (black) is applied. A means to define other values of foreground colour is provided within the syntax described in clause 9.

H.3.5 **mask layer**: The "middle" layer, bi-level data, in a 3-layer segmentation of a page containing a combination of bi-level and multilevel images. The bi-level mask layer selects for the foreground or background layer to be visible. A corresponding foreground pixel is selected for reproduction when a mask layer pixel value is "1". A corresponding background pixel is selected when a mask pixel value is "0".

H.3.6 **Strip**: An image swath, spanning the width of the page, which may consist of one or more layers.

H.3.7 **Joint Photographic Experts Group (JPEG)**, and also shorthand for the encoding method, described in CCITT Rec. T.81 | ISO/IEC 10918-1, which was defined by this group.

H.3.8 **Joint Bi-level Image Experts Group (JBIG)**, and also shorthand for the encoding method, described in ITU-T T.82 | ISO/IEC 11544, which was defined by this group.

H.3.9 **Modified Modified READ (MMR)** (READ is an acronym for Relative Element Address Designate) is shorthand for the lossless bi-level encoding method described in Recommendation T.6.

H.3.10 **Start of page marker (SOP)**, encoded as X'FFED' (TBD).

H.3.11 **End of page marker (EOP)**, encoded as X'FFEF' (TBD).

H.3.12 **Start of strip marker (SOSt)**, encoded as X'FFEE' (TBD).

H.4 Conventions

The conventions in CCITT Rec. T.81 | ISO/IEC 10918-1 apply to this Annex.

H.5 Image representation

This Annex includes description of a syntax for encapsulating two or more ITU-T encodings which are available in Recommendation T.30 on a single page.

A page is composed from a set of page-wide strips of image data. The strips are transmitted sequentially from the top to the bottom of the page.

The strips are composed of one or more layers. Each layer is coded using a recommended ITU-T coding method.

Information required to decode the page, such as coding types used within the layers, is specified within the page header (start of page marker segment). Strip length is specified within the strip header (start of strip marker segment).

Information required to decode a layer is included in the strip header and the layer data. The mask layer is transmitted first, followed by the background layer and then the foreground layer. Details of the syntax are described in Recommendation T.44.

The data stream is encoded for facsimile transfer using the Error Correction Mode (ECM) specified in Annex A of Recommendations T.4 and T.30. Pad characters (X'00', the null character,) may be added after ending marker within the last ECM frame of the page to complete the last frame, in alignment with Annex A/T.4.

H.5.1 Spatial resolution

The square spatial resolutions (same resolution in both horizontal and vertical direction) of Recommendation T.30 are available for use in this Annex. The resolution of the mask layer is fixed for the entire page. In general it is possible to define foreground and background layers of lower spatial resolution. Within a strip, varying spatial resolutions may be combined only when the background and foreground layers are integral factors of the mask resolution. For example, if the mask resolution is 400 pels/25.4 mm, the background and foreground layer may each be either 100, 200 or 400 pels/25.4 mm. All resolutions used must conform to ITU-T recommended values which are available in Recommendation T.30. The mask resolution is specified in the page header. The foreground and background resolutions are indicated in the layer data.

H.5.2 Strip and layer width

Strips always span the entire width of a page. The mask layer must always span the entire width.

This method takes advantage of the image width and length data included in the layer data. A foreground and/or background layer (e.g. JPEG data) is not required to span the entire width. In addition, a horizontal offset may be used to select a starting point to the right of the left strip boundary. This offset is expressed in the mask pixel units. A simple strip containing only background (e.g. JPEG data) or foreground (e.g. JBIG data) image data may use this feature also.

H.5.3 Strip and layer length

Two and three layer strips (2 & 3LS) have a maximum length of 256 lines (in mask layer resolution). This limits the data which must be buffered by the receiving apparatus.

Optionally, this maximum vertical strip size may be increased to the page size.

One layer strips (1LS) are not required to conform to a maximum strip length, and are only limited by page size.

Strip and mask layer length are always equal. Foreground and background layer lengths are less than or equal to strip lengths. In addition, a vertical offset may be used to select a starting point below the first scan line of the strip. This offset is expressed relative to the first scan line at the top of the strip and in the mask pixel units. A simple strip containing only background (e.g. JPEG) or foreground (e.g. JBIG) data may use this feature also.

H.5.4 Layer combination

The bi-level mask layer selects the appropriate multilevel layer for rendering. Background and foreground layers, or their default values, are combined per the value of the mask pixels. A corresponding foreground pixel or its default value, is selected when a mask pixel value is "1". A corresponding background pixel, or its default value, is selected when a mask pixel value is "0".

H.6 Layer transmission order

In 3LS, the bi-level mask data is transmitted first, followed by the background layer and then the foreground layer. In 2LS, the bi-level mask image data is transmitted first, followed by the background or foreground layer.

H.7 Data format

H.7.1 Overview

The MRC image data consist of a series of markers, parameters, and image data that specify the image coding parameters, image size, bit-resolution, and image data. The conventions of Annex B of CCITT Rec. T.81 | ISO/IEC 10918-1 are used broadly here, and the marker codes are classed as application markers.

The MRC page structure for this application has the following elements: Parameters, markers, and entropy-coded data segments. Parameters and markers are often organized into marker segments. Parameters are integers of length ½, 1, 2 or more octets. Markers are assigned two or more octet codes, an X'FF octet followed by an octet not equal to X'00' or X'FF'. This application defines three marker segments to denote the Start of Page (SOP), the Start of a Strip (SOSt), and the End of a Page (EOP). These markers are inserted by the encoder, and understood by the decoder in addition to all markers used for the coding methods (such as CCITT Rec. T.81 | ISO/IEC 10918-1 and ITU-T Rec. T.82 | ISO/IEC 11544). Details of the data format are described in Recommendation T.44.

H.7.2 Page data structure

The beginning of a MRC page is denoted by the Start of Page Marker Segment, followed by additional parameter segment, followed by page data, followed by EOP marker. The parameters of the additional parameter segment are optional, unless otherwise stated. Their purpose is to provide insight into reproduction of the image and as such are typically not mandatory for image reproduction. Skipping of any unrecognized additional parameter is appropriate. Page data consist of strips 1 to N. The Start of Page Marker Segment has the following structure:

SOP, Length of segment, ident, version, mask coder, background and foreground coder, mask resolution, width.

Additional parameter segment consists of one or more entries. Each entry has the following structure:

Entry Marker, Length of entry, ident, entry data.

Gamut range and illuminant information are two such additional parameters.

H.7.3 Strip data structure

The beginning of a strip is denoted by the Start of Strip Marker Segment, followed by strip data.

The first layer coded is the mask layer, followed by the background layer, and next the foreground layer (as appropriate). When there are two or more layers, the mask layer shall always be one of them. In the case of background only pixel data, no mask or foreground pixel data, the mask shall be fixed to "0". In the case of foreground only pixel data, no mask or background pixel data, the mask shall be fixed to "1".

Start of Strip Segment has the following structure:

SOSt, Length of segment, type of strip, background default colour, foreground default colour, offset of background layer relative to upper left-hand pixel in the strip, offset of foreground layer relative to upper left-hand pixel in the strip, strip length (number of lines), mask layer length in number of octets (when present).

H.7.4 Layer data structure

Layers are coded using ITU-T coding methods indicated in the Start of Page marker segment. No additional markers are added to the layer data. The coding mode and resolution of the background and foreground layers are defined in the layer data. The resolutions of the background and foreground layers are restricted to ITU-T recommended integral factors of the mask resolution.

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